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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/233,377	01/18/1999	GURTEJ S. SANDHU	MI22-1114	7580

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EXAMINER

PHAM, THANHHA S

ART UNIT PAPER NUMBER

2813

DATE MAILED: 12/30/2003

Please find below and/or attached an Office communication concerning this application or proceeding.

**Office Action Summary**

Application No.

09/233,377

Applicant(s)

SANDHU ET AL.

Examiner

Thanhha Pham

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --  
**Period for Reply**

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

**Status**

- 1) ☐ Responsive to communication(s) filed on \_\_\_\_.
- 2a) ☒ This action is **FINAL**. 2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

**Disposition of Claims**

- 4) ☒ Claim(s) 24,45,52-61 and 71-73 is/are pending in the application.
- 4a) Of the above claim(s) \_\_\_\_ is/are withdrawn from consideration.
- 5) ☐ Claim(s) \_\_\_\_ is/are allowed.
- 6) ☒ Claim(s) 24,45,52-61 and 71-73 is/are rejected.
- 7) ☐ Claim(s) \_\_\_\_ is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_ are subject to restriction and/or election requirement.

**Application Papers**

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on \_\_\_\_ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.  
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).  
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

**Priority under 35 U.S.C. §§ 119 and 120**

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).  
a) ☐ All b) ☐ Some \* c) ☐ None of:  
1. ☐ Certified copies of the priority documents have been received.  
2. ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_.  
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).  
\* See the attached detailed Office action for a list of the certified copies not received.
- 13) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application) since a specific reference was included in the first sentence of the specification or in an Application Data Sheet. 37 CFR 1.78.  
a) ☐ The translation of the foreign language provisional application has been received.
- 14) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121 since a specific reference was included in the first sentence of the specification or in an Application Data Sheet. 37 CFR 1.78.

**Attachment(s)**

- 1) ☒ Notice of References Cited (PTO-892) 4) ☐ Interview Summary (PTO-413) Paper No(s). \_\_\_\_
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948) 5) ☐ Notice of Informal Patent Application (PTO-152)
- 3) ☒ Information Disclosure Statement(s) (PTO-1449) Paper No(s) 31, 33 6) ☐ Other:

## DETAILED ACTION

This Office Action responses to Applicant's Amendment in Paper No.32 dated 10/08/03.

### ***Claim Rejections - 35 USC § 102***

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

**1. Claims 24 and 52-54 are rejected under 35 U.S.C. 102(b) as being anticipated by Ma et al ["Manipulation of the Ti/Si reaction path by introducing an amorphous Ge interlayer", 4<sup>th</sup> international conference on Solid-state and Integrated circuit technology Proceedings, 1995, pp 35-37].**

➤ With respect to claims 24 and 53, Ma et al, figs 1-3 and text pages 35-37, discloses a claimed method of forming a refractory metal silicide layer comprising:

forming a titanium metal layer over a silicon containing substrate (text page 35, Experimental Details, lines 5-7) **[claim 24];**

after forming the titanium metal layer, providing compressive stress inducing atoms comprising germanium into the titanium metal layer, the compressive stress inducing atoms (Ge) being larger than Si atoms (fig 2a, Results and Discussion, lines 1-18) **[claims 24 and 53];**

first annealing the titanium metal layer containing the compressive stress inducing atoms to form a titanium silicide layer substantially comprising a first crystalline phase after providing compressive stress inducing atoms (fig 2b, Results and Discussion, lines 18-27)[*claim 24*]; and

second annealing the titanium silicide layer substantially comprising the first crystalline phase under conditions effective to transform the titanium silicide layer to a denser layer substantially comprising a second crystalline phase (fig 2c, Results and Discussion, lines 28-41) [*claim 24*].

➤ With respect to claim 52, Ma et al (figs 2b and 2c) discloses the first crystalline phase is C49 and the second crystalline phase is C54.

**2. Claims 45, 55-58 and 71-73 are rejected under 35 U.S.C. 102(a) as being anticipated by Kawamura et al [JP 08-139056].**

➤ With respect to claims 45, 56, and 71-72, Kawamura et al, figs 1's and text paragraph [0001]-[0074], discloses a method of forming a refractory metal silicide comprising:

forming a compressive stress inducing material layer comprising material chosen from a group consisting of silicon nitride and silicon dioxide (gate insulating film being of silicon dioxide, fig 1A, text paragraph [0030]-[0032]: since the gate insulating film is formed of silicon dioxide, the gate insulating film has a characteristics of a compressive stress inducing material layer -- see *MPEP 2112: The claiming of a new use, new function or unknown property which is inherently present in the prior art does not necessarily make the claim patentable. In re Best, 562 F.2d1252, 1254, 195 USPQ 430, 433 (CCPA 1977); Where applicant claims a composition in terms of a function, property or characteristic and the composition of the prior art is the*

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*same as that of the claim but the function is not explicitly disclosed by the reference, the examiner may make a rejection under both 35 U.S.C. 102 and 103, expressed as a 102/103 rejection. "There is nothing inconsistent in concurrent rejections for obviousness under 35 U.S.C. 103 and for anticipation under 35 U.S.C. 102." In re Best, 562 F.2d 1252, 1255 n.4, 195 USPQ 430, 433 n.4 (CCPA 1977)) over a first side of a substrate (1) **[claims 45, 56, 71 and 72];***

forming a refractory metal silicide (6,7 on the gate insulating film of silicon dioxide, fig 1(B), text paragraph [0036]) on the compressive stress inducing material layer, the refractory metal silicide comprising a first crystalline phase **[claims 45 and 71];** and

after forming the refractory metal silicide comprising a the first crystalline phase, annealing the compressive stress inducing material layer and the refractory metal silicide comprising a first crystalline phase to form a refractory metal silicide of a second crystalline phase (6,7, fig 1(D), text paragraph [0039]-[0040]) **[claims 45 and 71].**

➤ With respect to claim 55 and 58, Kawamura et al (text paragraph [0036] and [0040]) discloses the first crystalline phase is C49 and the second crystalline phase is C54.

➤ With respect to claim 57 and 73, Kawamura et al (text paragraph [0036] and [0040]) discloses the refractory metal silicide comprises titanium silicide.

### ***Claim Rejections - 35 USC § 103***

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

**3. Claims 59-61 are rejected under 35 U.S.C. 103(a) as being unpatentable over Ma et al ["Manipulation of the Ti/Si reaction path by introducing an amorphous Ge interlayer", 4<sup>th</sup> international conference on Solid-state and Integrated circuit technology Proceedings, 1995, pp 35-37] in view of Anjum et al [US 5,470,794].**

➤ With respect to claim 59, Ma et al figs 1-3 and text pages 35-37, substantially discloses a claimed method of forming a refractory metal silicide layer comprising:

forming a titanium metal layer over a silicon containing substrate (text page 35, Experimental Details, lines 5-7);

after forming the titanium metal layer, providing compressive stress inducing atoms comprising germanium into the titanium metal layer, (fig 2a, Results and Discussion, lines 1-18);

first annealing the titanium metal layer containing the compressive stress inducing atoms to form a titanium silicide layer substantially comprising a first crystalline phase after providing compressive stress inducing atoms (fig 2b, Results and Discussion, lines 18-27); and

second annealing the titanium silicide layer substantially comprising the first crystalline phase under conditions effective to transform the titanium silicide layer to a denser layer substantially comprising a second crystalline phase (fig 2c, Results and Discussion, lines 28-41).

Ma et al does not expressly teach providing compressive stress inducing atoms comprising germanium into the titanium metal layer by implanting. Instead, Ma et al discloses providing the compressive stress inducing atoms Ge by thermal diffusion.

However, implanting is a known technique to provide compressive stress inducing atoms of germanium into the titanium metal layer. Moreover, Anjum et al (figs 4-8 and col 3 -8) discloses implanting Ge atoms into the titanium metal layer to reduce temperature of forming titanium silicide process.

Therefore, it would have been obvious for those skilled in the art to modify process of Ma et al by implanting compressive stress inducing atoms comprising germanium into the titanium metal layer as an known technique as taught by Anjum et al to reduce annealing temperature g in forming titanium silicide by salicidation process. By doing so, damages caused by thermal annealing effects to the device can be prevented.

- With respect to claim 60, Ma et al (fig 2b) discloses the first annealing comprises first annealing the titanium metal layer to form C49 crystalline phase.
- With respect to claim 61, Ma et al (fig 2c) discloses second annealing comprises second annealing the first crystalline phase to form C54 second crystalline phase.

### ***Response to Arguments***

4. Applicant's arguments filed on 10/08/03 have been fully considered but they are not persuasive.

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Regarding to Applicant's argument on page 8 about Ma et al, Applicant argues that Ma et al does not disclose forming a titanium metal layer and subsequently providing compressive stress inducing atoms into the titanium metal layer because Ma et al teaches sequentially growing 200 angstroms Ge film followed by a 500 angstroms Ti film. The argument is not persuasive because, after sequentially growing the Ge film followed by the Ti film, Ma et al performs heating 400°C for 30 min. to provide compressive stress atom Ge into the Ti film (see Ma et al, fig 2a and text page 36 of Results and Discussion the second paragraph). As being discuss above, Ma et al does teach forming a titanium metal layer and subsequently providing compressive stress inducing atoms into the titanium metal layer (by heating the Ge film and the Ti film at 400°C for 30 min).

Regarding to Applicant's argument on page 8-9 about Kawamura, Applicant argues that Kawamura does not teach the claimed invention because metal silicide 7 is not on the gate insulating film wherein the gate insulating film formed of silicon dioxide has characteristics of a compressive stress inducing material. The argument is not persuasive because fig 1(B) of Kawamura discloses forming the refractory metal silicide on the gate insulating film although the gate electrode 2 is formed therebetween. Since Applicant claims forming a refractory metal silicide on the compressive stress inducing material **NOT** forming a refractory metal silicide on and physically directly contact with the compressive stress inducing material, Kawamura still anticipated the claims 45, 55-58 and 71-73.



***Conclusion***

5. Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire **THREE MONTHS** from the mailing date of this action. In the event a first reply is filed within **TWO MONTHS** of the mailing date of this final action and the advisory action is not mailed until after the end of the **THREE-MONTH** shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than **SIX MONTHS** from the date of this final action.


6. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Thanhha Pham whose telephone number is (703) 308-6172 (before 02/05/04) or (571) 272-1696 (after 02/05/04). The examiner can normally be reached on Monday-Thursday 8:00 AM - 7:00 PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Carl Whitehead Jr., can be reached on (703) 308-4940 (before 02/05/04) or (571) 272-1702 (after 02/05/04). The fax phone number for the organization where this application or proceeding is assigned is (703) 308-3432.

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Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is (703) 308-0956.

Thanhha Pham



**JACK CHEN**  
**PRIMARY EXAMINER**